REMARKS

Reconsideration of the November 20, 2003 Official action is respectfully requested. Claims 1, 2, 4-7, 9, 11-17 and 20-29 are pending in the application for the Examiner's review and consideration. By this Amendment, Claim 23 has been canceled and new Claims 24-29 are submitted.

First Rejection

Claims 1, 2, 4-7, 9, 11-16 and 19-22 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over U.S. Patent No. 5,786,276 to Brooks et al. ("Brooks") in view of U.S. Patent No. 6,263,109 to Kim et al. ("Kim"). The reasons for the rejection are set forth in numbered paragraph 5, on pages 2-7 of the Official Action. This rejection is moot in view of the previous incorporation of the subject matter of Claim 10 into Claim 1.

Second Rejection

Claims 10 and 23 were rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Brooks and Kim in further view of U.S. Patent No. 6,355,573 to Okumura et al. ("Okumura"). The reasons for the rejection are set forth in numbered paragraph 6, on pages 7-8 of the Official Action. The Official Action alleges that Okumura discloses a method to perform a plasma etching reactor having a showerhead electrode and bottom electrode on which a substrate is supported, the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency. Claim 1 was amended to incorporate the subject matter of Claim 10. This rejection is respectfully traversed.

Reconsideration of the rejection is requested in view of the following legal precedent regarding rejections based on a combination of prior art references.

According to MPEP § 2143, to establish a *prima facie* case of obviousness, (1) "there must be some suggestion or motivation, either in references themselves or in the knowledge generally available to one of ordinary skill in the art, to ... combine reference teachings"; (2) "there must be a reasonable expectation of success"; and (3) "the prior art ... references when combined ... must teach or suggest all the claim limitations". The Patent Office has the initial burden of establishing each of these requirements of a *prima facie* case of obviousness. In re Piasecki, 223 USPQ 785, 787 (Fed. Cir. 1984) and In re Warner, 154 USPQ 173 (CCPA 1967).

As set forth in MPEP §2143.01 (page 2100-127, Rev. 1, Feb. 2003), if the proposed modification or combination of the prior art would change the principle of operation of the prior invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious. In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959).

As set forth in MPEP §2143.01 (page 2100-127, Rev. 1, Feb. 2003), additionally, if the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 221 USPQ 1125 (Fed. Cir. 1984).

As amended, Claim 1 sets forth a process for etching a silicon nitride layer with selectivity to an underlying and/or overlying dielectric layer, comprising introducing a

semiconductor substrate into a medium density plasma etching reactor, wherein the plasma reactor comprises a dual frequency parallel plate plasma reactor having a showerhead electrode and a bottom electrode on which the substrate is supported, the bottom electrode being supplied RF energy at two different frequencies or the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency which is greater than the first frequency, the semiconductor substrate having a layer of silicon nitride and the layer of silicon nitride having an underlying and/or overlying dielectric layer; supplying etching gas to the plasma etching reactor and energizing the etching gas into a plasma state, the etching gas including CH_3F and at least one oxygen reactant supplied to the plasma etching reactor at a flow rate ratio of oxygen reactant to CH_3F of 0.65 to 1.5; etching exposed portions of the silicon nitride layer with the plasma so as to etch openings in the silicon nitride layer with the plasma while providing an etch rate selectivity of the etching rate of the silicon nitride layer to the etching rate of the dielectric layer of at least about 10.

As set forth below, the combinations of features recited in Claim 1 and in the claims dependent thereon are not suggested by the combination of Brooks, Kim and Okumura.

In the Official Action, Brooks is cited for a disclosure of a method of plasma etching a silicon nitride layer using an etching gas including CH_3F and at least one oxygen reactant but the Official Action fails to recognize that the CF_4 containing etch gas of Brooks would be unsuitable for achieving selectivity between the etch rates of nitride and oxide layers in a capacitively coupled plasma reactor. That is, Brooks relates to chemical

downstream etching (Column 4, lines 11-18 and line 57 thru Column 5, line 5), wherein plasma is formed upstream of a gas distribution plate 140 (Column 7, lines 60-63). In Brooks, the plasma travels into the etch chamber by passing through the plate 140 and by the time the plasma reaches the wafer the plasma is reactive gas free of charged particles which would otherwise be present in a capacitively coupled plasma generated in proximity of the wafer[1]. As such, if the CF_4 containing etch gas of Brooks were to be energized into a plasma in a gap between a showerhead electrode and the wafer in a capacitively coupled plasma reactor, the highly ionized gas would contain a substantial amount of charged F particles which would attack the nitride and oxide to such extent that selectivity to oxide would be lost. Accordingly, because the Brooks process cannot be carried out in a capacitively coupled plasma chamber, it would not have been obvious to a person of ordinary skill in the art to carry out the Brooks process in a medium density plasma chamber.

Brooks discloses a process wherein the plasma is not formed in the etch chamber. Rather, the plasma in Brooks is created remotely from the etching chamber and then a downstream output (afterglow) of the plasma is applied to the wafer for etching (see column 2, lines 60-64). Accordingly, Brooks teaches away from generating the plasma within the etch chamber and modifying Brooks to generate plasma in the etch chamber would not achieve the selectivity desired in Brooks.

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1 See commonly-owned U.S. Patent No. 5,614,026 at column 4, lines 57-67 wherein is described an upstream microwave plasma generator located a distance such that ions in the generated plasma recombine with electrons to provide a reactive gas in the process chamber without charged particles.

With regard to Claim 1, because Brooks forms the plasma upstream of the gas distribution plate, it would not have been obvious to one of ordinary skill in the art to replace the Brooks plasma etch reactor with a dual frequency parallel plate reactor having a showerhead electrode and a bottom electrode on which the substrate is supported, the bottom electrode being supplied RF energy at two different frequencies or the showerhead electrode being supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency which is greater than the first frequency. Likewise, it would not have been obvious to carry out the Brooks process in a medium density parallel plate reactor as set forth in Claim 24 or in a capacitively coupled plasma reactor as set forth in Claim 29.

While Brooks discloses a process wherein the plasma is formed outside the etch chamber, the Official Action cites Kim for disclosure of a conventional capacitively coupled medium density plasma reactor, alleging that it would have been obvious to use Kim to modify Brooks to produce the method now recited in Claim 1. However, as explained above, it would not be possible to achieve the desired selectivity if the Brooks process were carried out in a medium density reactor. Kim discloses a completely different etch gas chemistry than Brooks and whether or not the Kim process can be carried out in a high density or medium density plasma reactor does not cure the deficiencies of Brooks, i.e., the Brooks CF_4 containing etch gas would not achieve the desired selectivity in a medium density plasma reactor.

Moreover, the plasma reactor of Kim would be unsuitable for Brooks' plasma etch process because it would change the principle of operation of Brooks. In Brooks, the plasma is formed upstream using highly fluorinating CF_4, a gas which would destroy selectivity if used in a capacitively coupled plasma system. Accordingly, because the proposed modification to Brooks would change the principle of operation of Brooks, the teachings of Brooks and Kim are not sufficient to render the claimed process *prima facie* obvious. See In re Ratti, 123 USPQ 349 (CCPA 1959).

Additionally, Kim discloses a "single-step plasma etching process *for etching both oxide and nitride* with selectivity to photoresist and silicon." See abstract (emphasis added). The Kim process is not intended to achieve selectivity between nitride and oxide materials. Instead, Kim seeks to etch nitride and oxide with selectivity to other materials. As such, a person of ordinary skill in the art would not have been led to look to Kim for a suggestion to modify Brooks process. Additionally, the proposed modification to Brooks, using the low selectivity to nitride etch of Kim, renders Brooks unsatisfactory for its intended purpose. Thus, there is no suggestion or motivation to make the proposed modification. See In re Gordon, 221 USPQ 1125 (Fed. Cir. 1984).

Further, Applicants respectfully submit that the deficiencies of Brooks and Kim noted above are not remedied by Okumura. Amended Claim 1 recites that the plasma reactor comprises a dual frequency parallel plate plasma reactor having a showerhead electrode and a bottom electrode on which the substrate is supported, the bottom electrode being supplied RF energy at two different frequencies or the showerhead electrode being

supplied RF energy at a first frequency and the bottom electrode being supplied RF energy at a second frequency which is greater than the first frequency. Claim 24 recites that the claimed process is carried out in a medium density parallel plate reactor and Claim 29 recites that the process is carried out in a capacitively coupled reactor. The combination of Brooks, Kim and Okumura fails to suggest these claimed processes.

Okumura seeks to deliver high-frequency power to an antenna as the top electrode and only mentions that the substrate-electrode can use high-frequency power so that ion energy that reaches the substrate can be controlled (see column 7, lines 6-10). Regardless, Okumura cannot overcome the deficiencies of Brooks and Kim discussed above. That is, there would be no reason to carry out the Brooks process in a medium density plasma reactor because the CF_4 gas would be so highly ionized that selectivity between nitride and oxide etching would be lost, a result contrary to the teachings of Brooks. Accordingly, withdrawal of the rejection is respectfully requested.

Third Rejection

Claims 17 was rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Brooks and Kim in further view of Applicants Admitted Prior Art. The reasons for the rejection are set forth in numbered paragraph 7, on page 9 of the Official Action. This rejection is now moot in view of the incorporation of the subject matter of Claim 10 into Claim 1.

Conclusion

It is submitted that the differences between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

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